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(54) **METHOD AND APPARATUS FOR MAKING AN ARTICLE FROM A FORMABLE MATERIAL**

VERFAHREN UND VORRICHTUNG ZUR HERSTELLUNG VON GEGENSTÄNDEN AUS VERFORMBAREM MATERIAL

PROCEDE ET DISPOSITIF DE FABRICATION D'UN ARTICLE A PARTIR D'UN MATERIAU POUVANT ETRE FORME

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(56) References cited:
WO-A-93/23225
DE-C- 525 515
FR-A- 2 361 217
GB-A- 880 666
US-A- 2 392 104
US-A- 3 237 243
US-A- 3 280 423
US-A- 4 623 117

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Description

[0001] The invention is in the field of needleless injectors which use a capsule for containing a liquid drug to be injected, and needle-type hypodermic syringe bodies.

[0002] Needleless injectors are used as an alternative to conventional hypodermic injectors to deliver medicaments through the patient's skin into the underlying tissues. Such injectors use a high pressure piston pump to dispense a jet of liquid drug with sufficient force to penetrate the skin, and thereafter deposit the drug into the dermal, subcutaneous or muscular tissues.

[0003] The drug is dispensed from a cylindrical chamber, having a fine orifice at one end through which the drug is discharged. A piston is slidingly and sealingly located in the chamber, and the drug is contained within the space between the orifice and piston. To make an injection, the orifice is placed on the skin, and by operating a release mechanism, the piston is acted upon by a force which may be derived from a spring, pressurised gas or chemical reaction.

[0004] The capsule may be filled by the user, or may be prefilled and pre-assembled to an actuator. In the latter case particularly, the materials from which the capsule and piston are constructed must be inert to the drug - i.e. they must not react with the drug chemically, nor physically, and must not contain harmful extractives that might contaminate the drug. The choice of materials is small: borosilicate glass is the most favoured capsule material when drugs must be stored for more than a few hours. If an alternative material is selected for the capsule, years of testing must be done to validate that material, whereas borosilicate glass has a known compatibility with most drugs.

[0005] During the injection, the pressure generated in the capsule is at least 100 bars, and it is preferable, in order to avoid leakage during injection, that the orifice is integral with the cylindrical chamber. Furthermore, the form and dimension of the orifice is critical to the injection performance, and for repeatable results these features should be made to close tolerances. However, glass is a difficult material to mould and maintain such close tolerances over many millions of components. One traditional method is to work the heated and softened end of a glass tube on a lathe, and by applying a shaping wheel or paddle, to close up one end onto a mandrel to form the orifice. This is a relatively crude method, and the only parameters that may be controlled accurately are the orifice diameter and the diameter of the surrounding glass: the length and entry profile of the orifice are left to chance because the process shapes only the outside of the tube and the orifice diameter. An alternative process is moulding, whereby a hot "gob" of molten glass is moulded in a die. This process is suitable for large components, but needleless injector capsules are seldom larger than 1 ml capacity, and such a small gob of glass loses its heat rapidly and is difficult to mould. Also the surface finish inside a moulded tube is not smooth enough for this application, nor is the bore parallel. Drawn tubing, which has an excellent surface finish and form, is the preferred starting material, but current working methods, as described, do not provide control of both inside and outside dimensions.

[0006] Conventional glass hypodermic syringes are made on automatic lathes from glass by working heat-softened tube, as previously described. Low cost disposable glass syringes are generally made with the hollow needle glued into a precisely formed hole in one end of the syringe body. The manufacturing process is relatively primitive, with low production rates and high reject rates.

[0007] US-A-3,237,243 discloses a method of manufacturing seamless plastics containers, with a top orifice. The method involves deforming a blank positioned over a mandrel using a die. The mandrel has a pin and the die has a corresponding opening, for receiving the pin. The orifice is defined by a part of the pin not received in the opening.

[0008] DE-C-525515 discloses a method of forming a neck in a glass tube which defines a narrow opening. A mandrel is used to define the inner profile of the neck opening, and is inserted into the opposite end of the tube. An outer forming tool is used to define the outer contour of the neck.

[0009] The present invention seeks to overcome the drawbacks of current glass tube forming methods by providing a means of forming the orifice, and the inside and outside profiles of a needleless injector capsule or hypodermic syringe body, which means has excellent repeatability and is capable of high speed production. The invention also aims to provide a process which enables an unobstructed orifice to be formed, even if the quantity of material in the starting blank is greater than required to form the article.

[0010] According to the invention there is provided a method of making an article from a formable material, the article having a cylindrical cavity communicating with the exterior via an orifice, wherein a blank having an open end is mounted on a first forming tool in a tube support with clearance therebetween, and the open end is engaged by a second forming tool while an end region of the blank adjacent the said open end is in a condition to permit it to be formed, the first forming tool having a pin extending therefrom, and the first and second tools are brought together to form the said end region into a desired shape, with the pin defining the said orifice, wherein the pin has a distal end, and the second tool has a distal face which, prior to forming, faces the distal end of the pin at a distance therefrom, and wherein during forming the said distal end of the pin and the said distal face of the second tool are brought into contact with one another, one of the pin and the distal face of the second tool being biased by a plunger, wherein the pin extends from the first forming tool at the end of forming by a length equal to the intended length of the orifice,

and wherein the first and second forming tools are brought into contact with each other at the end of forming.

[0011] The invention further provides an apparatus for making an article from a formable material, the article having a cylindrical cavity communicating with the exterior via an orifice, comprising a first forming tool having a tube support for receiving an open-ended blank with clearance therebetween, and a second forming tool for engaging an end region of the blank adjacent the open end thereof to form the same, the first forming tool having a pin extending therefrom, the tools being so arranged that when they are brought together to form the said end region into a desired shape the pin defines the said orifice, wherein the pin has a distal end, and the second tool has a distal face which, prior to forming, faces the distal end of the pin at a distance therefrom, the apparatus further comprising means for bringing the said distal end of the pin and the said distal face of the second tool into contact with one another during forming, one of the pin and the distal face of the second tool being biased by a plunger, wherein the pin extends from the first forming tool at the end of forming by a length equal to the intended length of the orifice, and wherein the first and second forming tools are brought into contact at the end of forming.

[0012] In a preferred embodiment of the invention, a glass tube, cut to length, is placed onto a mandrel having a profile to which the glass may be formed. The mandrel has a pin at its extreme for forming the orifice. The glass is rotated and heated on the end to be formed. When it is at the optimum forming consistency, a form tool having a profile to which the outside of the tube is to be formed, is applied to the exterior of the glass tube and presses the softened glass onto the mandrel and pin. Immediately before forming, the rotation of the glass tube is stopped; alternatively the external forming tool is rotated at the same speed as the tube, so that there is no relative movement between the tube and external form tool.

[0013] A detailed description of the invention will now follow, with reference to the accompanying drawings, in which:

Figure 1 shows a centreline section through a typical glass capsule, assembled to the nose of an actuator or power source;

Figure 2 shows a glass tube placed on a mandrel, with external form tool adjacent;

Figure 3 depicts the form tools in position having pressed the glass into the required shape;

Figures 4 and 5 show modified forming methods that will accommodate wide tolerance glass tube;

Figure 6 shows a hypodermic syringe body;

Figures 7a and 7b show a method according to the present invention of forming a capsule; and

Figures 8a and 8b show another method according to the present invention of forming a capsule.

[0014] Referring first to Figure 1, capsule 2 is a cylinder containing drug 2, and a piston 3 in contact with drug 2. The capsule 1 is retained in the nose 4 of a needleless injector actuator by retaining cap 5 bearing on shoulder 8 of the capsule 1. Cap 5 may be retained by screw threads 10, snap means or other suitable device. The discharge end of the interior of capsule 1 is characterised by a frusto-conical form 7 leading into the orifice 6. When the injector is operated, a ram 9 biassed in direction Y is released so as to engage and drive the piston 3 to discharge the drug 2 through orifice 6.

[0015] The ratio of the orifice length to diameter should be as small as practicable, and it is desirable that this should be no more than 2:1. This ratio has a significant effect on the flow resistance of the orifice: too high and the orifice resembles a tube with a corresponding increase in flow resistance. Typically, the orifice diameter may be within the range of 0.1mm to 0.5mm, with corresponding lengths within the range of 0.2mm to 1.0mm.

[0016] When performing an injection, the face 11 of the retainer 5 is pressed lightly on the patient's skin, and the area of face 11 provides sufficient support to prevent the injector capsule assembly sinking into the tissues. If the face 12 is flush or slightly behind face 11, the orifice is in very light contact with the skin, and an intradermal injection will result; a firm contact - i.e. face 12 protrudes slightly from face 11 - will result in a subcutaneous injection; and if face 12 protrudes considerably from face 11 thereby displacing and compressing adipose tissue, then the injection may be intramuscular. This is, of course, a generalisation, since other factors such as pressure and orifice size may be adjusted to achieve the required injection characteristics. Nevertheless, the relationship of the capsule face and retainer face must be controlled to achieve repeatable high quality injections.

[0017] The purpose of the frusto-conical form 7 which joins the cylindrical section of capsule 1 to the orifice 6 is to reduce turbulent energy losses as the drug is forced into the orifice 6, and also to minimise during injection the stresses within the glass walls of capsule 1 as the cylindrical bore reduces to the orifice 6.

[0018] The foregoing description covers the essential design requirements of a needleless injector capsule: there may be small variations but the great majority of injectors use a capsule having a form similar to that described.

[0019] Referring now to Figure 2, the material for the capsule 1 is a length of glass tube 1a, which is located over mandrel 20 and rests on tube support 23. The mandrel 20 has a frusto-conical form 7a, terminating in a pin 21. Located concentrically above the mandrel 20 is a form tool 22, which has a forming surface 27. A hole 24 in the form tool 22 is a close clearance fit relative to pin 21.

[0020] The forming process commences by heating the tube 1a in the area of the frusto-conical section 7a of mandrel 20 to a temperature sufficient to soften the

glass. Preferably, at least the mandrel 20 is rotated, (and more preferably the tube support 23 and mandrel 20 are rotated in unison, i.e. at the same speed and in the same direction), together with the glass tube 1a, during heating, so that the temperature of the glass is evenly distributed. Alternatively, the parts may remain stationary, the glass being heated by a ring burner. When the optimum temperature is reached, the form tool 22 is pressed onto the softened glass as shown in Figure 3, and thus shapes the glass tube 1a to form the capsule 1. This is done either with the support 23 and mandrel rotating together in unison, or with both stationary. The lengths of the orifice 6 and other features are controlled by the face 26 of the form tool 22 abutting face 25 of tube support 23, but other stop means may be equally effective.

[0021] The process described and illustrated by Figures 2 and 3 is idealised and would require an exact volume of glass tubing to be presented to the form tool. In practice, the dimensional tolerances of glass tube are quite large, and even if an accurate bore tubing is specified, the variation in wall thickness results in a wide variation in the outside diameter.

[0022] Figure 4 shows one possible method of overcoming this problem. The form tool 22a has a hole 24a which is substantially larger in cross-section than the corresponding pin 21a. This pin is shorter than the pin shown in Figure 2. In the illustration, hole 24 is frusto-conical, and has a substantially larger cross-section than the pin 21a at least for that length of the hole over which the pin extends. In other words, there is a substantial clearance between the pin and the surface defining the hole. The glass tube is cut so that the volume is slightly greater than required for the finished capsule, and during forming, any excess material is forced along hole 24a to form a blob 40, whereby the hole formed by pin 21a is closed. After removing the formed tube from the mandrel and tube support, the blob 40 is cut at X-X and the cut face is flame polished to remove sharp edges and to smooth out any surface roughness. If necessary, after cutting, the face may be ground before flame polishing.

[0023] Figure 5 shows another possible method of dealing with excess material. Again, the volume of the glass tube is slightly more than the finished capsule, and during forming, the excess glass is allowed to spread into the form tool to make a rim 50, the length Z of which may vary according to the amount of excess glass. This method has the additional advantage that the diameter of the rim 50 is controlled, regardless of the wall thickness tolerance.

[0024] It is important that the orifice is formed without any glass "flash", and whilst Figures 3 and 5 show pin 21 entered into hole 24, the annular clearance between pin and hole must be very small to prevent the ingress of molten glass which would form a thin skin or "flash" across the orifice 6. As a result, the alignment of the forming tool and mandrel is critical in Figures 3 and 5 to ensure that the pin 21 enters hole 24 without bending or jamming. This requires accurate and costly tools.

[0025] Figures 7a and 7b show a method according to the present invention of preventing flash formation around the orifice without the necessity of very accurate tool alignment. Plunger 60 is a sliding fit within forming tool 22b and a compression spring 64 bears on plunger 60 which carries a collar 63 fixed thereto. The total sliding movement permitted is controlled by the faces of the collar 63 and abutment faces 65 and 67 within a cavity 66 in the forming tool 22b. The mandrel 20b carries a pin 21b which has a flat distal face 62, and plunger 60 has a flat distal face 61. When the glass is formed, substantially as already described, the faces 61 and 62 cooperate to form a tight "shut-off" to prevent molten glass forming a thin skin over the end of the orifice in the capsule. The force of the shut-off is determined by the spring 64.

[0026] Figures 8a and 8b show a similar arrangement, but in this case the pin 21c is spring loaded by a compression spring 64c and slides in mandrel 20c. When the forming tool 22c and the mandrel 20c are brought together to form the glass, a face 70 of pin 21c cooperates with a face 71 of the forming tool 22c to form a tight shut-off.

[0027] The foregoing methods of forming the glass tube may be applied with equal efficacy to the production of glass syringes, as shown in Figure 6. In this case, the diameter of hole 100 may be required to be closely controlled to accept a hollow needle: the needle may be bonded into the glass with a minimum thickness of adhesive. Alternatively, the frusto-conical tip 200 may be dimensioned to accept a so-called Luer-fitting needle, i. e. a needle with an adaptor having a co-operating internal taper by which means the needle may be frictionally retained on the syringe tip.

[0028] The method of forming tubing to make needleless injector capsules and hypodermic syringes may be applied to materials other than glass where conventional forming methods are inappropriate.

Claims

1. A method of making an article from a formable material, the article having a cylindrical cavity communicating with the exterior via an orifice, wherein a blank (1a) having an open end is mounted on a first forming tool (20b; 20c) in a tube support with clearance therebetween, and the open end is engaged by a second forming tool (22b; 22c) while an end region of the blank (1a) adjacent the said open end is in a condition to permit it to be formed, the first forming tool (20b; 20c) having a pin (21b;21c) extending therefrom, and the first and second tools are brought together to form the said end region into a desired shape, with the pin (21b;21c) defining the said orifice, wherein the pin (21b;21c) has a distal end (62;70), and the second tool (22b;22c) has a

distal face (61;71) which, prior to forming, faces the distal end (62;70) of the pin (21b;21c) at a distance therefrom, and wherein during forming the said distal end (62;70) of the pin (21b) and the said distal face (61;71) of the second tool (22b) are brought into contact with one another, one of the pin (21b; 21c) and the distal face (61;71) of the second tool being biased by a plunger (60), wherein the pin (21b;21c) extends from the first forming tool (20b; 20c) at the end of forming by a length equal to the intended length of the orifice, and wherein the first and second forming tools (20b, 22b; 20c, 22c) are brought into contact with each other at the end of forming.

2. A method according to claim 1, wherein the cavity is circular cylindrical.

3. A method according to claim 1 or 2, wherein the distal face (61) of the second tool (22b) is biassed by the plunger (60), the plunger being spring-loaded, and the pin (21b) produces movement of plunger (60) against the spring loading during moulding.

4. A method according to claim 3, wherein the extent of movement of the plunger (60) is controlled by opposing faces which are formed thereon and which engage, in use, with abutment faces (65,67) formed in the second tool.

5. A method according to claim 1 or 2, wherein the pin (21c) is movably mounted in the first forming tool (20c) for movement towards and away from the second forming tool (22c), and as the tools are brought together during moulding the distal end (70) of the pin (21c) first engages the distal face (71) of the second forming tool (22c) and is then moved into the first forming tool (20c) by the second forming tool (22c).

6. A method according to claim 5, wherein the pin (21c) is biassed by a biassing means (64c) towards the said second forming tool (22c), the said engagement with the second forming tool (22c) producing movement against the force of the biassing means (64c).

7. A method according to claim 6, wherein the said biassing means (64c) is a compression spring.

8. A method according to any preceding claim, wherein the tools do not rotate during moulding.

9. A method according to any of claims 1 to 7, wherein the tools rotate in unison during moulding.

10. A method according to any preceding claim, wherein the said article is a body for a capsule adapted for use in a needleless injector.

11. A method according to any one of claims 1 to 9, wherein the said article is a syringe body.

12. A method according to any preceding claim, wherein the formable material is glass.

13. A method according to any preceding claim, wherein the end region of the blank is brought into its condition to permit it to be formed, by heating.

14. A method according to claim 13, wherein the first forming tool rotates during heating of the blank.

15. A method according to claim 13, wherein the first forming tool does not rotate during heating of the blank.

16. An apparatus for making an article from a formable material, the article having a cylindrical cavity communicating with the exterior via an orifice, comprising a first forming tool (20b;20c) having a tube support for receiving an open-ended blank (1a) with clearance therebetween, and a second forming tool (22b;22c) for engaging an end region of the blank (1a) adjacent the open end thereof to form the same, the first forming tool (20b;20c) having a pin (21b;21c) extending therefrom, the tools being so arranged that when they are brought together to form the said end region into a desired shape the pin (21b;21c) defines the said orifice, wherein the pin (21b;21c) has a distal end (62;70), and the second tool (22b;22c) has a distal face (61;71) which, prior to forming, faces the distal end (62;70) of the pin (21b;21c) at a distance therefrom, the apparatus further comprising means for bringing the said distal end of the pin (21b;21c) and the said distal face (61; 71) of the second tool (22b;22c) into contact with one another during forming, one of the pin and the distal face of the second tool being biased by a plunger (60), wherein the pin extends from the first forming tool at the end of forming by a length equal to the intended length of the orifice, and wherein the first and second forming tools (20b, 22b;20c,22c) are brought into contact at the end of forming.

17. An apparatus according to claim 16, wherein the cavity is circular cylindrical.

18. An apparatus according to claim 16 or 17, wherein the second tool (22b) is provided with the plunger (60), which is spring-loaded, and the apparatus is so arranged that the pin (21b) produces movement of the plunger (60) against the spring loading during moulding.

19. An apparatus according to claim 18, wherein the ex-

tent of movement of the plunger (60) is controlled by opposing faces which are formed thereon and which are engageable, in use, with abutment faces formed in the second tool.

20. An apparatus according to claim 16 or 17, wherein the pin (21c) is movably mounted in the first forming tool (20c) for movement towards and away from the second forming tool, whereby, in use, as the tools are brought together during moulding the distal end (70) of the pin (21c) first engages the second forming tool (22c) and is then moved into the first forming tool (20c) by the second forming tool.

21. An apparatus according to claim 20, wherein the pin (21c) is biassed by a biassing means (64c) towards the second forming tool (22c), the said engagement with the second forming tool producing movement, in use, against the force of the biassing means (64c).

22. An apparatus according to claim 21, wherein the said biassing means (64c) is a compression spring.

23. An apparatus according to any one of claims 16 to 22, comprising means for heating the said end region of the blank (1a) to bring it into a condition to permit it to be moulded.

24. An apparatus according to any one of claims 16 to 23, comprising means for rotating the first forming tool.

25. An apparatus according to claim 24, comprising means for rotating the second forming tool.

Patentansprüche

1. Verfahren für die Herstellung eines Teils aus einem verformbaren Material, bei dem dieses Teil einen zylindrischen Hohlraum besitzt, der über eine Öffnung mit der Außenseite kommuniziert, und bei dem ein Rohling (1a) mit einem offenen Ende mit einem Spiel auf einem ersten Formwerkzeug (20b; 20c) in einem Rohrhalter montiert wird, und das offene Ende von einem zweiten Formwerkzeug (22b; 22c) erfasst wird, während sich ein Ende des Rohlings (1a), das an dem offenen Ende liegt, in einem Zustand befindet, in dem es verformt werden kann, wobei das erste Formwerkzeug (20b; 20c) einen daraus hervorstehenden Zapfen (21b; 21c) aufweist, und das erste und das zweite Formwerkzeug zusammengeführt werden, um dieses Ende in die gewünschte Form zu bringen und der Zapfen (21b; 21c) diese Öffnung bildet, wobei dieser Zapfen (21b; 21c) ein hinteres Ende (62; 70) aufweist, und das zweite Formwerkzeug (22b; 22c) eine hintere Fläche (61;71) aufweist, welche vor der Verformung in einem gewissen Abstand gegenüber dem hinteren Ende (62; 70) des Zapfens (21b) liegt, und bei dem während der Verformung das hintere Ende (61; 70) des Zapfens (21b) und die hintere Fläche (61; 71) des zweiten Formwerkzeuges (22b) zusammengeführt werden, wobei einer der Zapfen (21b; 21c) und die hintere Fläche (61; 71) des zweiten Formwerkzeuges mit Hilfe eines Druckkolbens (60) gespannt werden, und der Zapfen (21b; 21c) aus dem ersten Formwerkzeug (20b: 20c) am Ende der Verformung über eine Länge hervorsteht, die gleich der gewünschten Länge der Öffnung ist, und bei dem das erste und das zweite Formwerkzeug (20b, 22b; 20v,22c) bei der Beendigung der Verformung zusammengeführt werden.

2. Verfahren nach Anspruch 1,
dadurch gekennzeichnet, dass
der Hohlraum eine zylindrische Kreisform hat.

3. Verfahren nach einem der Ansprüche 1 oder 2,
dadurch gekennzeichnet, dass
das hintere Ende (61) des zweiten Formwerkzeuges (22b) durch einen Druckkolben (60) gespannt wird, wobei der Druckkolben federbelastet wird, und der Zapfen (21b) während der Formung eine Bewegung des Druckkolbens (60) gegen die Federkraft bewirkt.

4. Verfahren nach Anspruch 3,
dadurch gekennzeichnet,dass
das Ausmaß der Bewegung des Druckkolbens (60) durch gegenüberliegende Flächen kontrolliert wird, welche darauf ausgebildet sind und die im Betrieb an Anschlagflächen (65, 67) anliegen, welche in dem zweiten Formwerkzeug ausgebildet sind.

5. Verfahren nach einem der Ansprüche 1 oder 2,
dadurch gekennzeichnet, dass
der Zapfen (21c) beweglich auf dem ersten Formwerkzeug (20c) montiert ist, um sich dem zweiten Formwerkzeug (22c) zu nähern oder sich von ihm zu entfernen, während die Formwerkzeuge während der Formung das hintere Ende (70) des Zapfens (21c) zuerst das hintere Ende (71) des zweiten Formwerkzeuges (22c) erfassen und dann mit Hilfe des zweiten Formwerkzeuges (22c) in das erste Formwerkzeug (20c) bewegt werden.

6. Verfahren nach Anspruch 5,
dadurch gekennzeichnet, dass
der Zapfen (21c) mit Hilfe einer Spannvorrichtung (64c) gegen das zweite Formwerkzeug (22c) gedrückt wird, wobei dieser Eingriff mit diesem zweiten Formwerkzeug (22c) eine Bewegung gegen die Kraft der Spannmittel (64c) bewirkt.

7. Verfahren nach Anspruch 6,
dadurch gekennzeichnet, dass
diese Spannmittel (64c) aus einer Druckfeder bestehen.

8. Verfahren nach einem der vorausgegangenen Ansprüche,
dadurch gekennzeichnet,dass
sich die Werkzeuge während der Verformung nicht drehen.

9. Verfahren nach einem der Ansprüche 1 bis 7,
dadurch gekennzeichnet,dass
sich diese Werkzeuge während der Verformung gleichzeitig drehen.

10. Verfahren nach einem der vorausgegangenen Ansprüche,
dadurch gekennzeichnet, dass
dieses Teil der Körper einer Kapsel ist, die für eine nadellose Spritze verwendet wird.

11. Verfahren nach einem der Ansprüche 1 bis 9,
dadurch gekennzeichnet, dass
dieses Teil der Körper einer Spritze ist.

12. Verfahren nach einem der vorausgegangenen Ansprüche,
dadurch gekennzeichnet, dass
das Formmaterial aus Glas besteht.

13. Verfahren nach einem der vorausgegangenen Ansprüche,
dadurch gekennzeichnet, dass
der Endbereich des Rohlings in einen Zustand gebracht wird, in dem er durch Erwärmung verformt werden kann.

14. Verfahren nach Anspruch 13,
dadurch gekennzeichnet, dass
sich das erste Formwerkzeug während der Erwärmung des Rohlings drehen kann.

15. Verfahren nach Anspruch 13,
dadurch gekennzeichnet, dass
sich das erste Formwerkzeug während der Erwärmung des Rohlings nicht drehen kann.

16. Vorrichtung für die Herstellung eines Teils aus einem formbaren Material an, wobei dieses Teil einen zylindrischen Hohlraum aufweist, der über eine Öffnung mit der Außenseite kommuniziert, und die ein erstes Formwerkzeug (20b; 20c) mit einem Rohrhalter für die Aufnahme mit einem gewissen Spiel eines Rohlings (1a) mit einem offenen Ende aufweist, sowie ein zweites Formwerkzeug (22b; 22c) für das Ergreifen des Endbereichs des Rohlings (1a) an seinem offenen Ende, um diesen zu formen, wobei aus dem ersten Formwerkzeug ein Zapfen (21b; 21c) hervorsteht, und in der die Werkzeuge so angeordnet sind, dass sie, wenn sie zusammengeführt werden, um den Endbereich in die gewünschte Form zu bringen, der Zapfen (21b; 21c) diese Öffnung herstellt, wobei dieser Zapfen (21b; 21c) ein hinteres Ende (62; 70) und das zweite Werkzeug (22b; 22c) eine hintere Fläche (61; 71) aufweist, die vor dem Verformen in einem gewissen Abstand gegenüber dem hinteren Ende (62; 70) des Zapfens (21b; 31c) liegt, wobei diese Vorrichtung außerdem Mittel aufweist, um dieses hintere Ende dieses Zapfens (21b; 21c) und die hintere Fläche (61; 71) des zweiten Werkzeugs (22b; 22c) während der Verformung miteinander in Kontakt zu bringen, wobei einer der Zapfen und die hintere Fläche des zweiten Werkzeugs mit Hilfe eines Druckkolbens (60) gespannt werden, und der Zapfen am Ende der Verformung aus dem ersten Formwerkzeug über eine Länge hervorsteht, die gleich der gewünschten Länge der Öffnung ist und die ersten und zweiten Formwerkzeuge (20b, 22b; 20c, 22c) am Ende der Verformung miteinander in Kontakt gebracht werden.

17. Vorrichtung nach Anspruch 16,
dadurch gekennzeichnet, dass
der Hohlraum die Form eines kreisförmigen Zylinders hat.

18. Vorrichtung nach einem der Ansprüche 16 oder 17,
dadurch gekennzeichnet, dass
das zweite Werkzeug (22b) mit dem federbelasteten Druckkolben (60) ausgestattet ist und die Vorrichtung so angeordnet ist, dass der Zapfen (21b) während der Formung die Bewegung des Druckkolbens (60) gegen die Federkraft bewirkt.

19. Vorrichtung nach Anspruch 18,
dadurch gekennzeichnet, dass
dass der Bereich der Bewegung des Druckkolbens (60) durch gegenüberliegende Flächen kontrolliert wird, die auf diesem Druckkolben angeordnet sind und die im Betrieb mit Anschlagflächen in Eingriff treten, die auf dem zweiten Werkzeug vorgesehen sind.

20. Vorrichtung nach einem der Ansprüche 16 oder 17,
dadurch gekennzeichnet, dass
der Zapfen (21c) beweglich in dem ersten Werkzeug (20c) angeordnet ist, um sich gegenüber dem zweiten Werkzeug hin- und herbewegen zu können, so dass wenn während der Verformung die Werkzeuge zusammengeführt werden, die hintere Fläche (70) des Zapfens (21c) zuerst das zweite Formwerkzeug (22c) erfasst ,und dann mit Hilfe des zweiten Formwerkzeugs in das erste Formwerkzeug (20c) bewegt wird.

21. Vorrichtung nach Anspruch 20,
dadurch gekennzeichnet, dass
der Zapfen (21c) mit Hilfe einer Spannvorrichtung (64c) gegen das zweite Formwerkzeug (22c) gedrückt wird, so dass der Eingriff mit dem zweiten Formwerkzeug im Betrieb die Bewegung gegen die Federkraft der Spannvorrichtung (64c) erzeugen kann.

22. Vorrichtung nach Anspruch 21,
dadurch gekennzeichnet, dass
diese Spannvorrichtung (64c) aus einer Druckfeder besteht.

23. Vorrichtung nach einem der Ansprüche 16 bis 22,
dadurch gekennzeichnet, dass
sie Mittel für die Erwärmung des Endbereiches des Rohlings (1a) aufweist, um ihn in den Zustand zu bringen, in dem er verformt werden kann.

24. Vorrichtung nach einem der Ansprüche 16 bis 23,
dadurch gekennzeichnet, dass
sie Mittel für die Rotation des ersten Formwerkzeuges aufweist.

25. Vorrichtung nach Anspruch 24,
dadurch gekennzeichnet, dass
sie Mittel für die Rotation des zweiten Formwerkzeuges aufweist.

Revendications

1. Procédé de fabrication d'un article à partir de matériau pouvant être mis en forme, l'article ayant une cavité cylindrique communiquant avec l'extérieur via un orifice, dans lequel une ébauche (1a) ayant une extrémité ouverte est montée sur un premier outil de mise en forme (20 ; 20c) d'un support tubulaire avec un espace entre eux, et l'extrémité ouverte coopère avec un second outil de mise en forme (22b ; 22c) alors qu'une région d'extrémité de l'ébauche (1a) adjacente à ladite extrémité ouverte est dans un état lui permettant d'être mise en forme, le premier outil de mise en forme (20b ; 20c) ayant une broche (21b ; 21c) s'étendant à partir de celui-ci, et le premier et le second outil sont amenés ensemble à mettre en forme ladite zone d'extrémité selon une forme voulue, la broche (21b ; 21c) définissant ledit orifice, la broche (21b ; 21c) ayant une extrémité distale (62 ; 70) et le second outil (22b ; 22c) ayant une face distale (61 ; 71) qui, avant la mise en forme, est en vis-à-vis de l'extrémité distale (62, 70) de la broche (21b ; 21c) à distance de celle-ci, et dans lequel pendant la mise en forme ladite extrémité distale (62 ; 70) de la broche (21b) et ladite face distale (61 ; 71) dudit second outil (22b) sont amenées en contact l'une avec l'autre, un élément parmi la broche (21b ; 21c) et la face distale (61, 71) du second outil étant contraint par un piston plongeur (60), dans lequel la broche (21b ; 21c) s'étend à partir du premier outil de mise en forme (20b ; 20c) à l'extrémité de mise en forme sur une longueur égale à la longueur prévue de l'orifice, et dans lequel le premier et le second outil de mise en forme (20b, 22b ; 20c, 22c) sont amenés en contact l'un avec l'autre à la fin de la mise en forme.

2. Procédé selon la revendication 1, dans lequel la cavité est cylindrique circulaire.

3. Procédé selon la revendication 1 ou 2, dans lequel la face distale (61) du second outil (22b) est contrainte par le piston plongeur (60), le piston plongeur est chargé par ressort, et la broche (21b) produit un déplacement du piston plongeur (60) à l'encontre de la charge élastique pendant le moulage.

4. Procédé selon la revendication 3, dans lequel l'étendue du déplacement du piston plongeur (60) est commandée par des faces opposées qui sont formées sur celui-ci et qui sont, en utilisation, en contact avec des faces de butée (65, 67) formées dans le second outil.

5. Procédé selon la revendication 1 ou 2, dans lequel la broche (21c) est montée de manière mobile dans le premier outil de mise en forme (20c) pour se déplacer en direction du second outil de mise en forme (22c) et en s'éloignant de celui-ci, et lorsque les outils sont amenés ensemble pendant le moulage l'extrémité distale (70) de la broche (21c) vient en contact tout d'abord avec la face distale (71) du second outil de mise en forme (22c) et ensuite est déplacée dans le premier outil de mise en forme (20c) par le second outil de mise en forme (22c).

6. Procédé selon la revendication 5, dans lequel la broche (21c) est contrainte par des moyens de mise en contrainte (64c) vers ledit second outil de mise en forme (22c), ledit contact avec le second outil de mise en forme (22c) produisant un déplacement à l'encontre de la force des moyens de mise en contrainte (64c).

7. Procédé selon la revendication 6, dans lequel lesdits moyens de mise en contrainte (64c) sont un ressort de compression.

8. Procédé selon l'une quelconque des revendications précédentes, dans lequel les outils ne tournent pas pendant un moulage.

9. Procédé selon l'une quelconque des revendications 1 à 7, dans lequel les outils tournent à l'unisson pendant un moulage.

10. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit article est un corps destiné à une capsule adaptée pour être utilisée dans un injecteur sans aiguille.

11. Procédé selon l'une quelconque des revendications 1 à 9, dans lequel ledit article est un corps de seringue.

12. Procédé selon l'une quelconque des revendications précédentes, dans lequel le matériau pouvant être mis en forme est du verre.

13. Procédé selon l'une quelconque des revendications précédentes, dans lequel la zone d'extrémité de l'ébauche est amenée dans sa condition lui permettant d'être mise en forme, par chauffage.

14. Procédé selon la revendication 13, dans lequel le premier outil de mise en forme tourne pendant le chauffage de l'ébauche.

15. Procédé selon la revendication 13, dans lequel le premier outil de mise en forme ne tourne pas pendant le chauffage de l'ébauche.

16. Dispositif pour fabriquer un article à partir d'un matériau pouvant être mis en forme, l'article ayant une cavité cylindrique communiquant avec l'extérieur via un orifice, comportant un premier outil de mise en forme (20b ; 20c) ayant un support formant tube destiné à recevoir une ébauche à extrémité ouverte (1a) avec un espace entre eux, et un second outil de mise en forme (22b ; 22c) pour coopérer avec une zone d'extrémité de l'ébauche (1a) adjacente à son extrémité ouverte pour mettre en forme celle-ci, le premier outil de mise en forme (20 ; 20c) ayant une broche (21b ; 21c) s'étendant à partir de celui-ci, les outils étant agencés de telle sorte que lorsqu'ils sont amenés ensemble pour mettre en forme ladite zone d'extrémité selon une forme voulue, la broche (21b ; 21c) définit ledit orifice, la broche (21b ; 21c) ayant une extrémité distale (62 ; 70) et le second outil (22b ; 22c) ayant une face distale (61 ; 71) qui, avant la mise en forme, est en vis-à-vis de l'extrémité distale (62 ; 70) de la broche (21b ; 21c) à distance de celle-ci, le dispositif comportant en outre des moyens pour amener ladite extrémité distale de la broche (21b ; 21c) et ladite face distale (61 ; 71) du second outil (22b ; 22c) en contact l'une avec l'autre pendant la mise en forme, un élément parmi la broche et la face distale du second outil étant contraint par un piston plongeur (60), la broche s'étendant à partir du premier outil de mise en forme à l'extrémité de mise en forme sur une quantité égale à la longueur prévue de l'orifice, et les premier et second outils de mise en forme (20b, 22b ; 20c, 22c) sont amenés en contact à la fin de la mise en forme.

17. Dispositif selon la revendication 16, dans lequel la cavité est cylindrique circulaire.

18. Dispositif selon la revendication 16 ou 17, dans lequel le second outil (22b) est muni du piston plongeur (60), qui est chargé par ressort, et le dispositif est agencé de sorte que la broche (21b) produit un déplacement du piston plongeur (60) à l'encontre de la charge élastique pendant un moulage.

19. Dispositif selon la revendication 18, dans lequel l'étendue du déplacement du piston plongeur (60) est commandée par des faces opposées qui sont formées sur celui-ci et qui peuvent venir en contact, en utilisation, avec des faces de butée formées dans le second outil.

20. Dispositif selon la revendication 16 ou 17, dans lequel la broche (21c) est montée de manière mobile dans le premier outil de mise en forme (20c) pour se déplacer en direction du second outil de mise en forme et en s'éloignant de celui-ci, de sorte que, en utilisation, lorsque les outils sont amenés ensemble pendant un moulage, l'extrémité distale (70) de la broche (21c) vient tout d'abord en contact avec le second outil de mise en forme (22c) et ensuite est déplacée dans le premier outil de mise en forme (20c) par le second outil de mise en forme.

21. Dispositif selon la revendication 20, dans lequel la broche (21c) est contrainte par des moyens de mise en contrainte (64c) en direction du second outil de mise en forme (22c), ledit contact avec le second outil de mise en forme produisant un déplacement, en utilisation, à l'encontre de la force des moyens de mise en contrainte (64c).

22. Dispositif selon la revendication 21, dans lequel lesdits moyens de mise en contrainte (64c) sont un ressort de compression.

23. Dispositif selon l'une quelconque des revendications 16 à 22, comportant des moyens pour chauffer ladite zone d'extrémité de l'ébauche (1a) pour l'amener dans un état lui permettant d'être moulée.

24. Dispositif selon l'une quelconque des revendications 16 à 23, comportant des moyens pour mettre en rotation le premier outil de mise en forme.

25. Dispositif selon la revendication 24, comportant des moyens pour mettre en rotation le second outil de mise en forme.

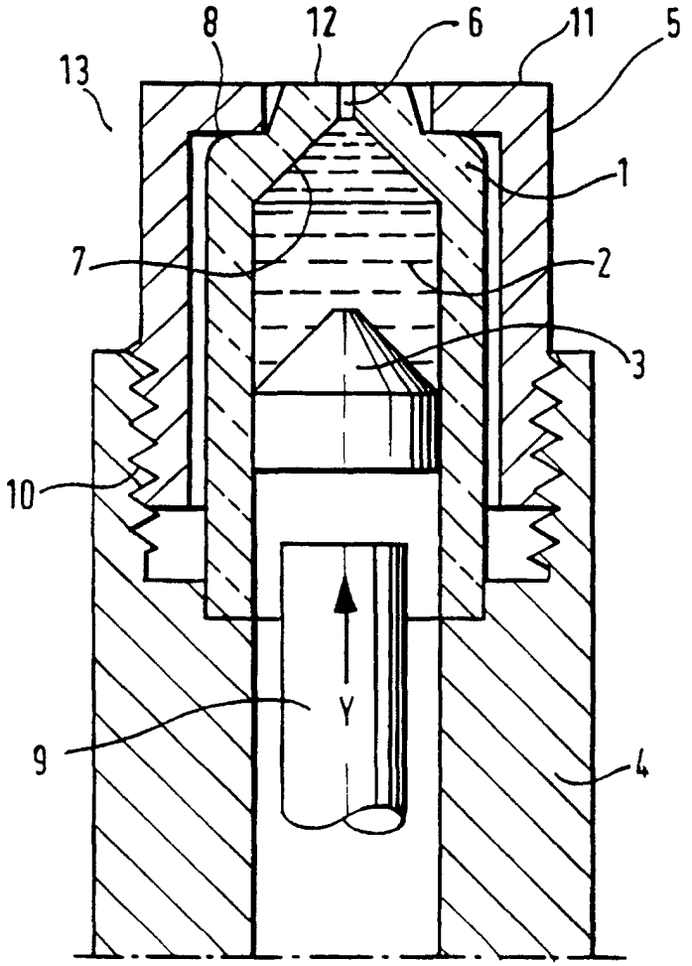

FIG.1.

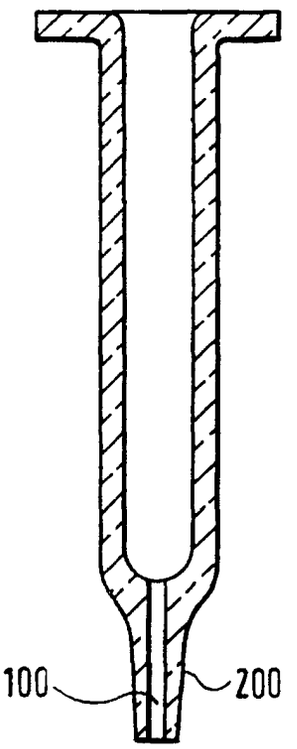

FIG.6.

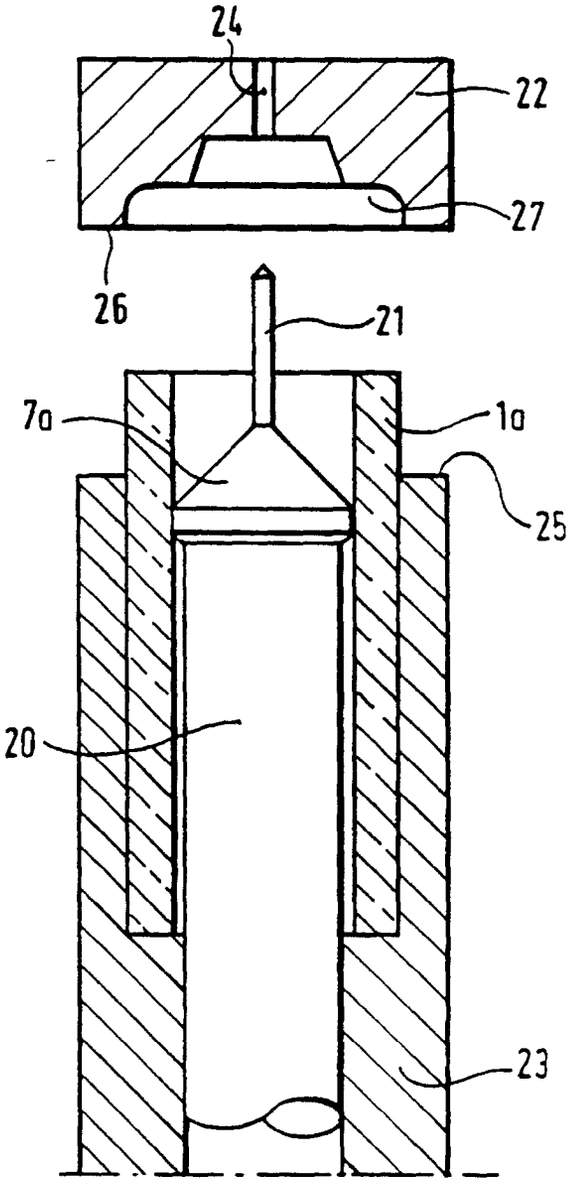

FIG.2.

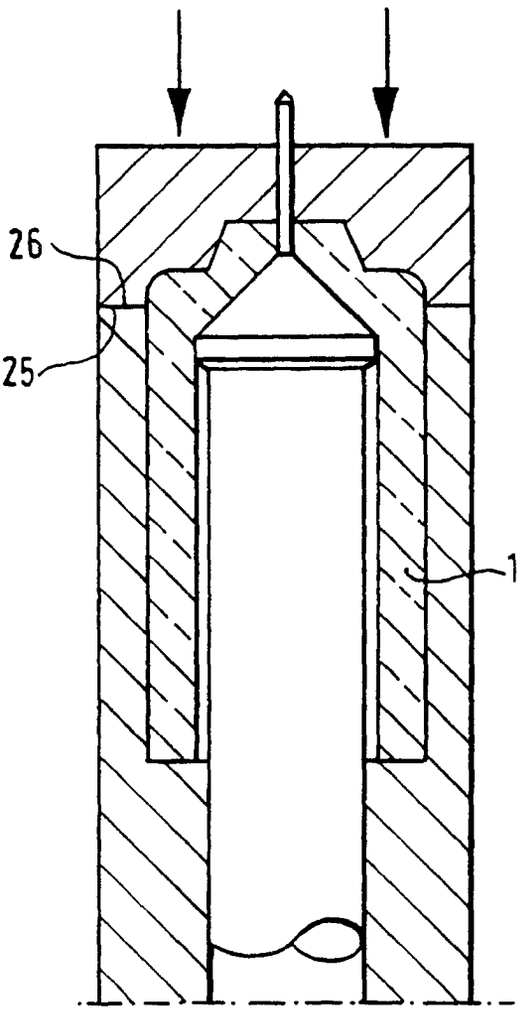

FIG.3.

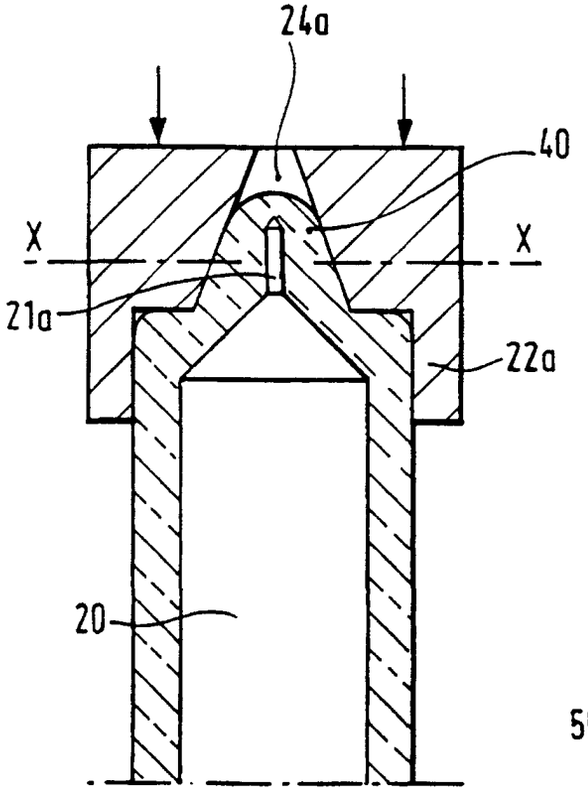

FIG.4.

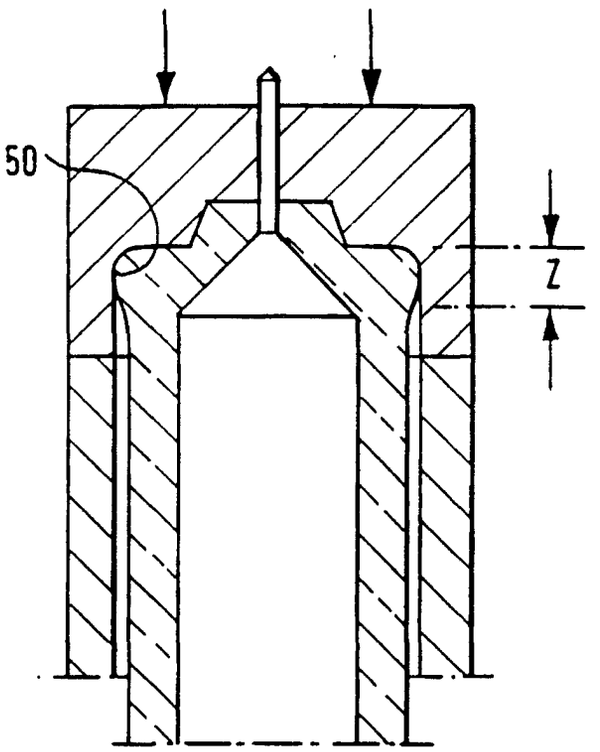

FIG.5.

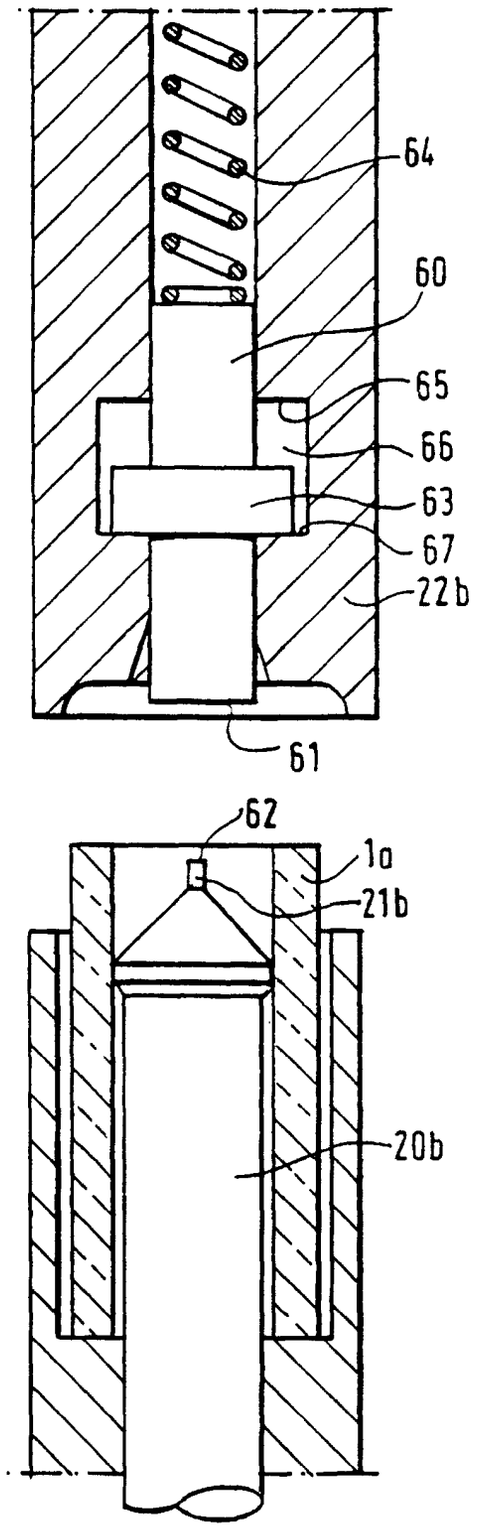

FIG.7a.

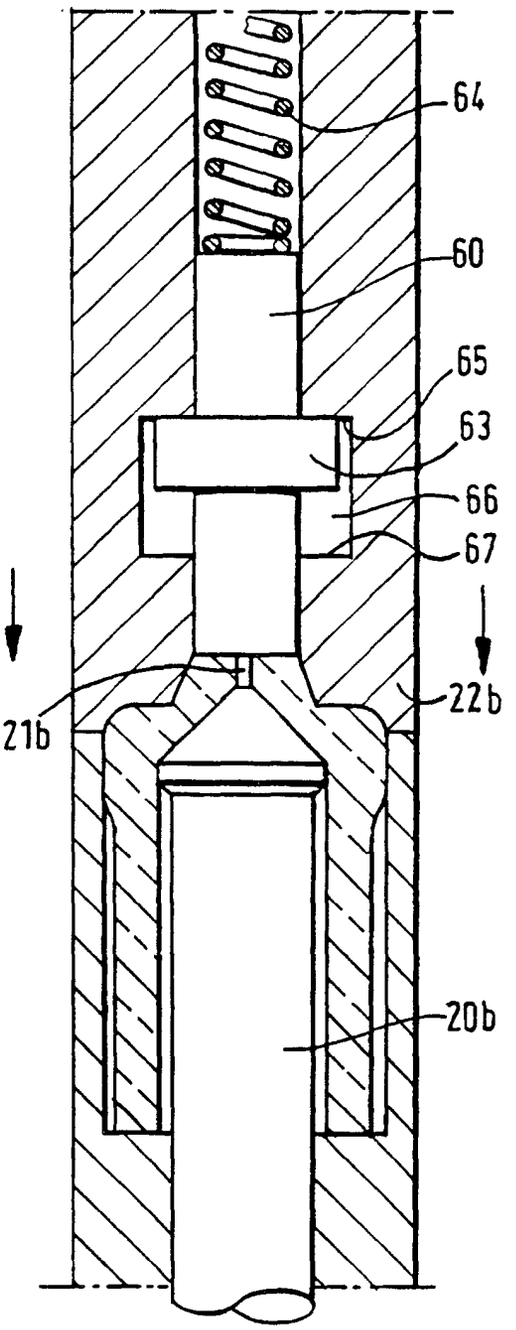

FIG.7b.

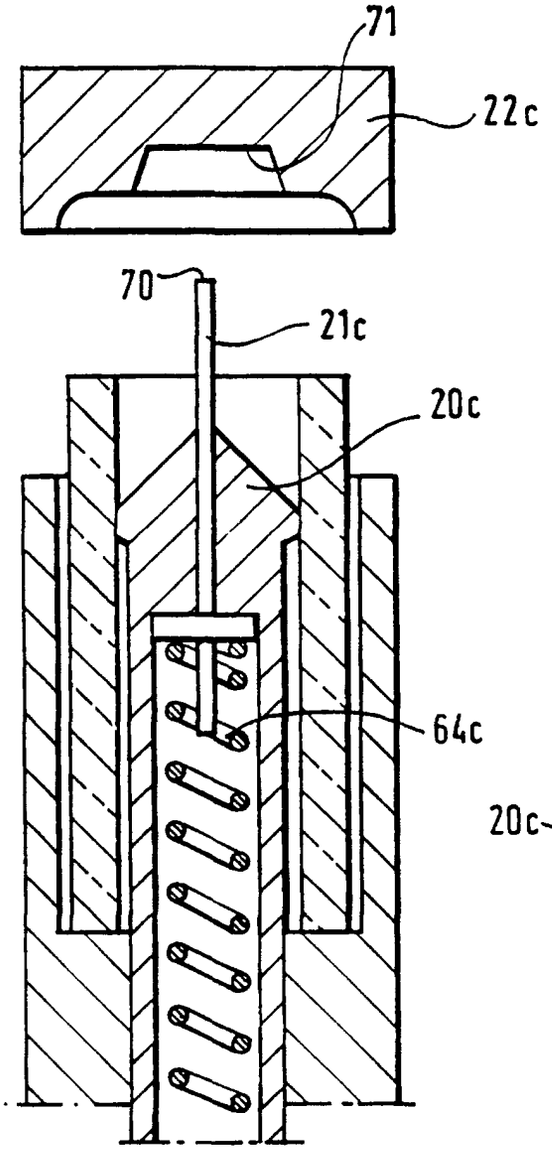

FIG.8a.

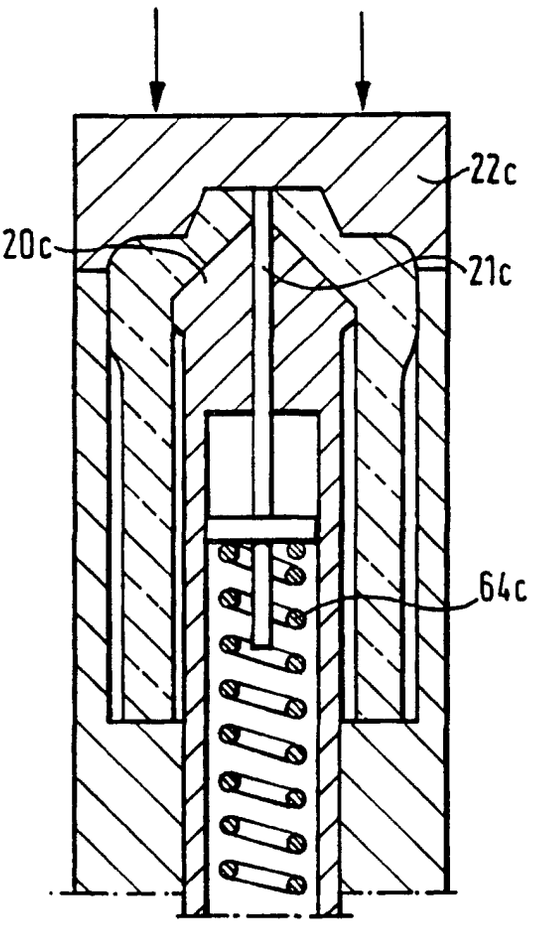

FIG.8b.